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ABSTRACT

In the serial position memory task, a series of stimulus cards are placed face down in a row in front of the subject. A card identical to the stimulus card is then shown to the subject, who is required to indicate the position of this card in the stimulus array. The present three studies investigated the possibility that the labeling effect found with children is at least in part a modality effect similar to that found with adult subjects. As in previous research with subject-produced labels: (1) addition of the label facilitated performance only for the recency portion of the list; (2) this effect did not vary systematically with age; (3) memory for the first serial position improved markedly between the ages of 5 1/2 and 6 1/2; (4) labels alone were superior to pictures at the end of the list, but pictures were superior to labels at the beginning; and (5) combined picture and label presentation appeared to follow the curve for pictures at the beginning of the list and that for labels at the end. The results are discussed in terms of modality and mediation effects in children's short-term memory. (Author)

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VISUAL AND AUDITORY MEMORY IN CHILDREN

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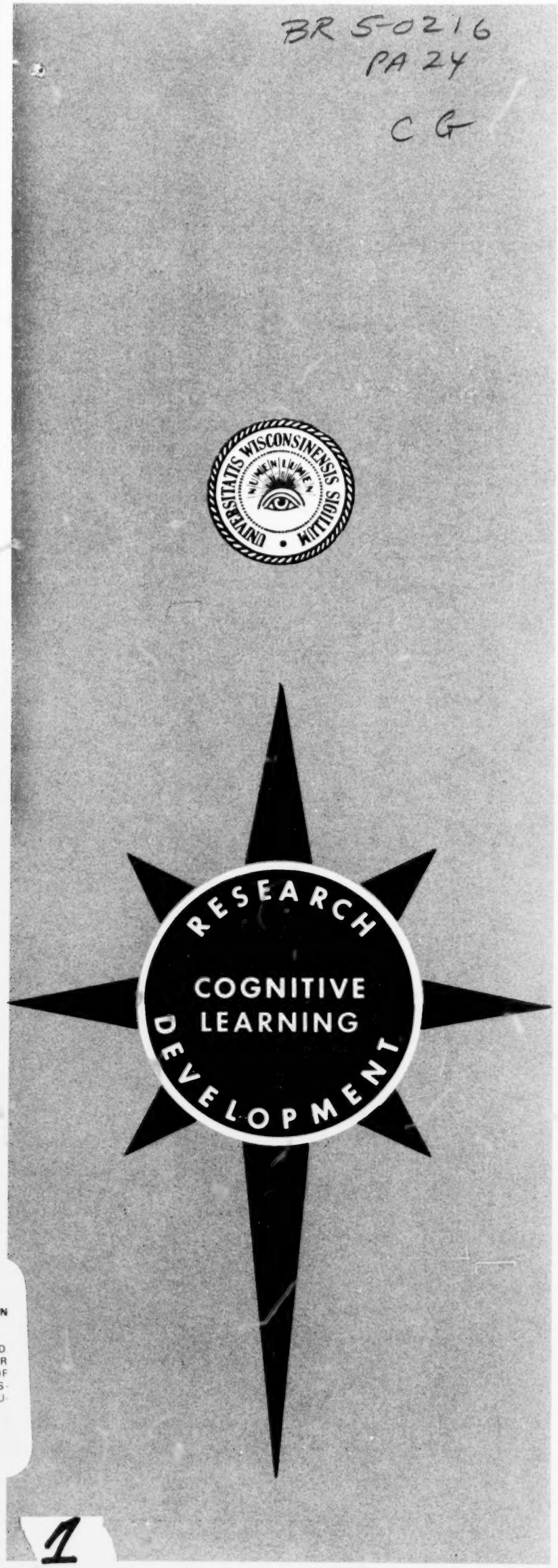

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VISUAL AND AUDITORY MEMORY IN CHILDREN

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Report from the Project on Variables and
Processes in Cognitive Learning

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STATEMENT OF FOCUS

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the programming of instruction for individual students; to clarify the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

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I
INTRODUCTION

In the serial position memory task (Atkinson, Hansen, & Bernbach, 1964) a series of stimulus cards are placed face down in a row in front of the subject. Another (cue) card, identical to one of the stimulus cards, is then shown to the subject, who is required to indicate the position of this card in the stimulus array.

Several recent studies using this task have shown that when children overtly label a visually presented stimulus series, their serial position memory is facilitated (Bernbach, 1967; Hagen & Kingsley, 1968; Hagen, Winsberg, & Wolff, 1968; Kingsley & Hagen, 1969).

Hagen and Kingsley (1968) and Kingsley and Hagen (1969) found that this facilitation effect interacts with the serial position of the correct item, being restricted to the last few items of the list. In the early portion of the list the label had no effect (Kingsley & Hagen, 1969) or even a slight inhibitory effect (Hagen & Kingsley, 1968).

Kingsley and Hagen (1969) obtained the recency facilitation effect in 5-year olds who did not spontaneously rehearse. The precise role played by the label is therefore not clear. In the same study no facilitation was found for a group of subjects who were instructed to covertly label the stimuli, suggesting that the effect depends on overt production of the label.

Several recent studies with adults comparing memory for labeled and unlabeled digits have found that labeling results in improved performance only for the last few items of the list (Crowder, 1970; Ellis, 1969). Labeling was found to have no effect or an inhibiting effect on recall for items early in the list. Thus the results for adults are similar to those found with children in the studies reviewed above, providing additional evidence that the labeling effect in children's memory is not necessarily in the same class as typical "mediation " effects, particularly when it is restricted to the recency portion of the list.

One possible explanation is that the facilitation effect depends not on the production of the label, but rather on its availability to the auditory modality. Studies which have compared pure auditory with pure visual presentation of lists have found that the auditory serial position curve is steeper than the visual. Auditory presentation is superior to visual at the end of the list while the reverse is true at the beginning (Conrad & Hull, 1968; Craik, 1969; Murdock, 1967). These and other findings have led to the hypothesis that storage systems in memory are modality-specific, with different systems having different decay functions (Craik, 1969; Ellis & Hope, 1968; Glanzer & Cunitz, 1966; Murdock, 1967).

The present series of experiments was designed to test the possibility that the labeling effect found with children is at least in part a modality effect similar to that found with adult subjects. In order to do this it was necessary to compare the serial position functions for pictures presented alone with that for labels presented alone using the serial position memory task. It was predicted that if a modality effect is present an interaction should be found between the two methods of presentation, with labels superior at the end of the list and pictures superior at the beginning.

II
EXPERIMENT I

In practice, the isolation of the label effect necessitates a paradigm in which the experimenter produces the label, because if the subject labels the stimulus he must first visually observe it. The first experiment investigates the effect of experimenter-produced labels on serial position memory in children ranging in age from 5 to 11 years to determine whether this procedure results in a facilitation effect comparable to that found in studies using subject-produced labels.

METHOD

Subjects

Thirty children, from grades K through 5 were divided into five age groups, of mean age 5-8.8, 6-5.3, 7-6.7, 8-7.2, and 10-7.7. The design called for three boys and three girls at each age level. However mis-scheduling resulted in four boys and two girls being tested in the 7-8 year-old group, and two boys and four girls in the 8-9 year-old group.

Materials

The stimuli were brightly colored children's picture cards portraying a boat, bear, truck, clown, doll, and cat. A cardboard box was used to rearrange the card sequence between trials.

Procedure

Subjects were tested in two sessions separated by one week. All subjects received the Picture (P) condition on Day 1 and Picture plus Label (PL) condition on Day 2. This constant order of conditions was used in order to insure against training a labeling strategy in subjects who would not normally use one. General practice effects in this task have been found to be negligible in previous research.

On each day subjects were given practice on two- and three-card problems and were then given the 12 trial test series using four stimulus cards. The 12 test trials consisted of three replications of four stimulus sequences presented in random order. Each of these sequences tested a different serial position and a different picture was correct at each serial position. In spite of the repetitive nature of the series, no improvement over trials within a condition was found, and subjects offered no other indication of increasing familiarity with the sequence.

On each trial the stimulus cards were held up one by one and then placed face down in a row extending from the subject's left to his right. Each card was displayed for approximately 2 seconds with a 2-second delay before presentation of the next card. In the P condition the experimenter said nothing. In the PL condition the presentation of each stimulus card was accompanied by the pronunciation of the name of the object depicted on the card.

When the subject chose a stimulus card it was turned over. If the choice was correct the experimenter said, "Good," and gave the subject 2 M & M candies. If the choice was incorrect, the experimenter said, "That's not it," without indicating the correct alternative.

Results

An analysis of variance was performed on the number of correct responses at each serial position. The factors were Presentation Mode, i.e., P versus PL, Serial Position, Age, and Sex. Age was significant ($F(4, 20) = 4.82$; $p < .01$), as was Serial Position ($F(3, 18) = 29.50$; $p < .01$). The effect of Conditions was marginally significant with performance in the PL

condition superior to that in the P condition ($F(1,20) = 2.89$; $p = .10$). A within-sex comparison of P and PL conditions showed that PL was superior to P for males ($t(14) = 1.98$), but not for females ($t(14) = .53$). Girls' performance tended to be superior to that of boys ($F(1,20) = 3.51$; $p < .10$).

Two of the second order interactions with serial position were significant, Conditions x Serial Position ($F(3,18) = 3.77$; $p < .05$) and Age x Serial Position ($F(12,48) = 2.24$; $p < .025$). No other interactions were significant.

The Conditions x Serial Position interaction is shown in Figure 1. A slight inhibiting effect of the label was found at the first position ($t(29) = 1.80$; $p < .10$). At the third position, however, addition of the label facilitated performance ($t(29) = 3.08$; $p < .01$).

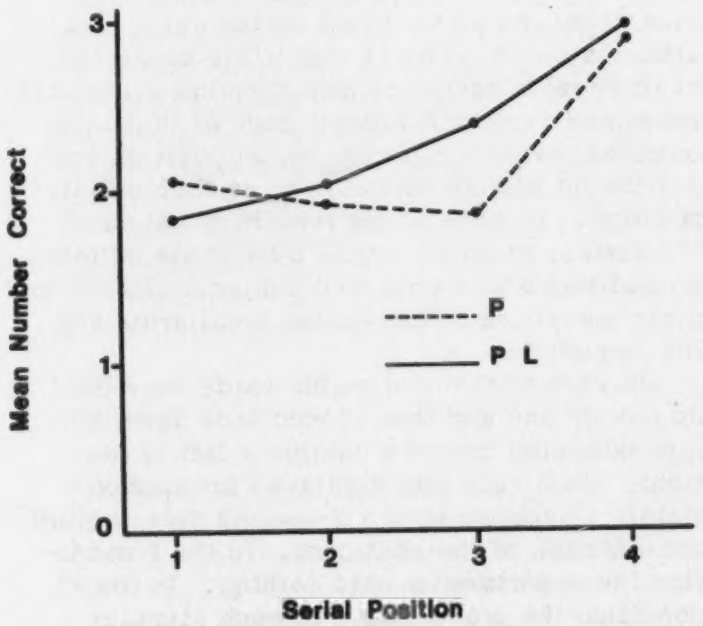

Figure 1. Mean Number of Correct Responses as a Function of Serial Position and Presentation Conditions—Picture Alone (P) or Picture plus Verbal Label (PL). (Experiment 1)

As can be seen in Figure 2, the Age x Serial Position interaction is largely accounted for by the large increase between 5 1/2 and 6 1/2 years in performance at the first position.

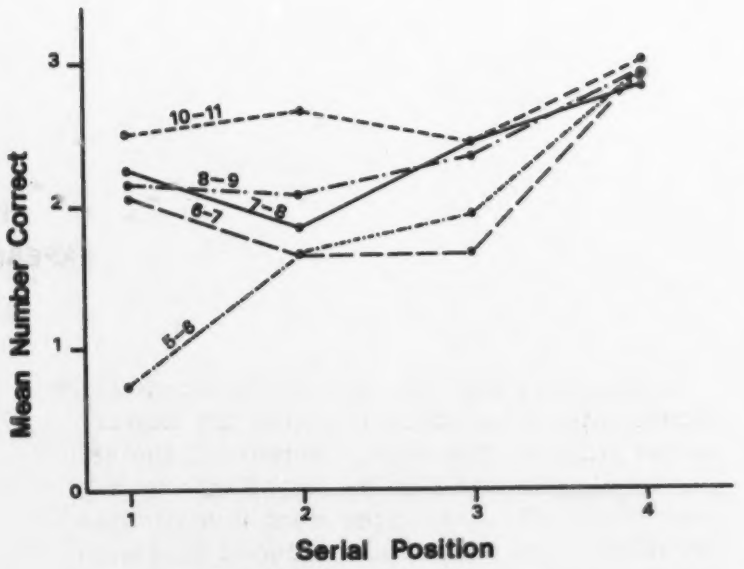

Figure 2. Mean Number of Correct Responses as a Function of Serial Position and Age Level. (Experiment 1)

Discussion

Labels were found to facilitate serial position memory, except for a slight inhibitory effect at the first serial position.

The labeling effect in the present study is similar to that found in other studies using subject-produced labels, demonstrating that production of the label is not necessary for its occurrence. The results agree with those of Crowder (1970) who used labeled or unlabeled digit sequences with adults. He found facilitation from labeling at the ends of the sequences whether the stimuli were labeled by subject or experimenter. Consistent with this finding, the labeling effect in the present study did not interact with age.

An age-related change did occur, however, at the beginning of the sequence, with an abrupt improvement in performance at the first serial position between 5-1/2 and 6-1/2 years of age. It is not unreasonable to hypothesize that this change reflects the adoption of a rehearsal strategy which could utilize labels produced either overtly by the experimenter or covertly by the subject.

III
EXPERIMENT 2

The results of Experiment 1 were similar to those found in previous child research using subject-produced labels. The experimenter-produced labeling method, however, has the advantage of allowing the isolation of the effect of the label from the combined effect of picture and label. This was done in the second experiment by adding a condition in which blank cards were substituted for the picture cards in the PL condition. In addition the conditions of Experiment 1 were replicated using a more adequately counterbalanced procedure. The data from Experiment 1 suggested that the subjects in the 5-1/2—6-1/2 year group had not yet developed a rehearsal strategy. Therefore the present study used 5-year olds in order to eliminate strategy considerations in the interpretation of the results.

METHOD

Subjects

Forty-eight Kindergarten children between the ages of 5-3 and 6-1 were tested individually with 16 subjects in each experimental condition. Mean ages are 5-7.1, 5-7.7, and 5-6.9 for the P, L, and PL conditions, respectively. Equal numbers of boys and girls were tested in each condition.

Materials

Five of the six picture cards used in Experiment 1 were used in the present experiment. Ten sequences, each five cards long, were constructed such that each serial position was tested twice and each picture was correct twice. No picture was correct more than once at a given serial position. Two different orderings of the 10 sequences were used.

Procedure

The procedure was approximately the same as in Experiment 1 for the Picture (P) and Picture plus Label (PL) conditions. In the Label (L) condition a series of five blank cards was arrayed in front of the subject. As each card was displayed the name of the corresponding picture card in the prearranged series was pronounced by the experimenter. A sixth blank card was then displayed to the subject with the instruction, "Find the _____," with the name of the appropriate test card supplied by the experimenter. Half of the subjects received Order 1 and the remaining half Order 2.

Results

Figure 3 shows the mean number correct at each serial position for each condition. The data are collapsed over the two sexes and two orders. An analysis of variance showed that Serial Position was significant ($F(4,33) = 125.57$; $p < .001$). The two orders were also significantly different ($F(1, 36) = 6.46$; $p < .025$). No other effects were significant.

In a second analysis, the first two positions combined were tested against the combined fourth and fifth positions. The Conditions effect was marginally significant ($F(2,36) = 2.39$; $p = .10$). Mean number correct for the P, L, and PL conditions was .95, 1.00, and 1.16, respectively. The Serial Position x Conditions interaction was significant ($F(2,36) = 4.61$; $p < .025$). This interaction reflects in part the fact that at the first two positions P performance is superior to L, whereas at the least two positions this order is reversed. Serial position was again significant ($F(1,36) = 38.14$; $p < .001$, as was the Order effect ($F(1,36) = 5.58$; $p < .025$). Finally, the Serial Position x Sex interaction was significant ($F(1,36) =$

9.53; $p < .005$). Females performed better than males at the first two positions, but worse at the last two positions.

An analysis was also done of the average deviation of the chosen position from the correct one. The effect of Conditions was significant ($F(2,36) = 3.34$; $p < .05$), with the PL condition showing the smallest deviation. No other effects were significant.

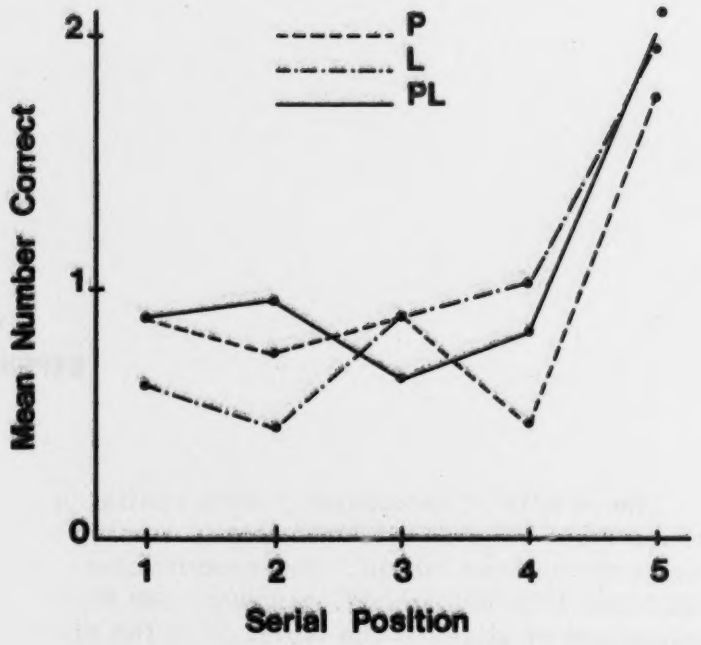

Figure 3. Mean Number of Correct Responses as a Function of Serial Position and Presentation Condition—Picture Alone (P), Label Alone (L), or Picture Plus (PL). (Experiment 2)

IV
EXPERIMENT 3

Since the effects of Experiment 2 were small, a more sensitive replication study was carried out. A within-subject design was used in which each subject received all three methods of presentation. Also three tests were made at each serial position. Of particular interest was the apparent interaction between serial position and presentation conditions found in Experiment 2.

METHOD

Subjects

Twenty-four nursery school children, 12 boys and 12 girls, served as subjects. They ranged in age from 4-10 to 5-4, with a mean age of 5-3.2 years for the boys and 5-2.0 years for the girls. Each subject served in three sessions separated by at least 1 day.

Materials

The same cards were used as in the previous experiment. A list of 15 sequences, each five pictures long, was constructed such that each serial position was tested three times with three different pictures. Each of the five pictures was correct three times. Only one sequence order was used.

Procedure

The procedure of Experiment 2 was followed except that each subject was tested in all three conditions. Each of the six possible orderings of conditions was given to four subjects. Using a metronome as a timer each card was presented for 2 seconds, with a 2-second interval between cards.

Results

Figure 4 shows mean number of items correct at each serial position for the three presentation

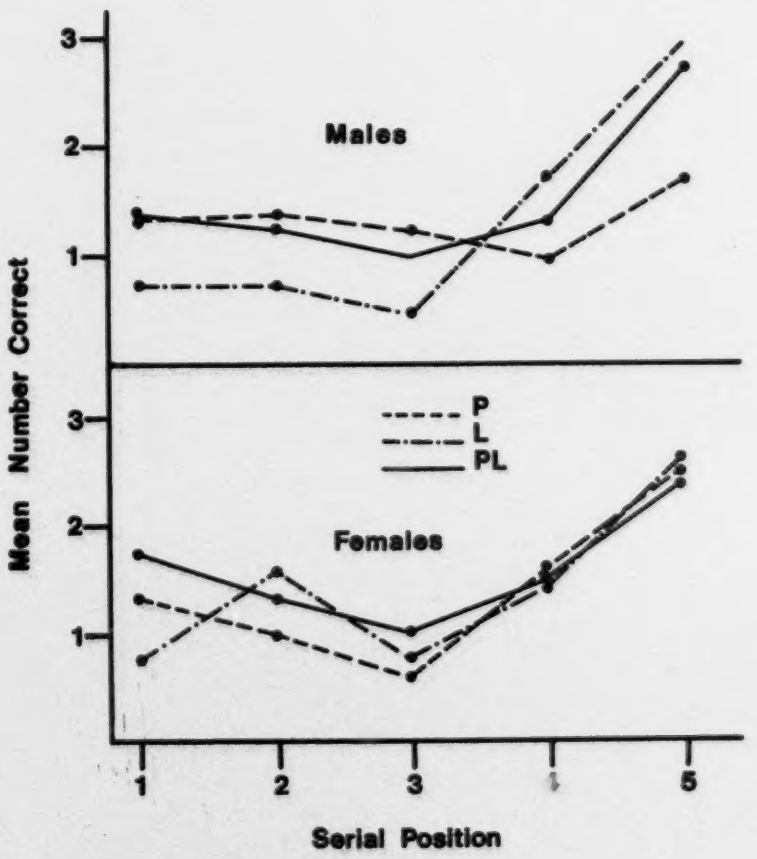

Figure 4. Mean Number of Correct Responses as a Function of Serial Position and Presentation Condition. (Experiment 3)

conditions. The functions are presented separately for boys and girls. The selected contrast between the PL condition and the mean of the P and L conditions was significant ($F(1,22) = 4.41$; $p < .05$). The contrast between P and L was insignificant ($F < 1$). The interaction of the P and L conditions with serial position was replicated, with P superior to L at the first three positions, but inferior at the last two positions. The linear component of the interaction was highly significant ($F(1,22) = 15.59$; $p < .001$). None of the higher order components of the interaction was significant. This linear component did, however, interact with sex ($F(1,22) = 9.83$; $p < .005$). From Figure 4 it appears that while for the females there is a crossover of the P and L conditions after the first serial position, there is no systematic superiority for the L condition in the latter positions of the sequence. A comparison within sex of the P and PL conditions shows the PL condition superior to the P for males ($t(11) = 2.59$; $p < .025$), but not for females ($t(11) = 1.02$), similar to the results of Experiment 1.

8

V
GENERAL DISCUSSION

Summarizing the results of the three experiments, as in previous experiments in which subjects are required to label picture stimuli, adding experimenter-produced labels to pictures resulted in a small degree of facilitation compared to presentation of pictures alone. This facilitation was restricted to the recency portion of the list. While labels alone resulted in the same overall performance as pictures, the two modes of presentation interacted with serial position, labels being superior at the end of the list, pictures at the beginning.

Each of these results has been found in adult studies of memory which have manipulated the labeling variable using printed and/or spoken words or digits. Since these results in adults appear to be independent of strategy, it has been assumed that they reflect stable characteristics of modality-specific memory systems.

An explanation for the often-found facilitation effect in labeling studies with children is suggested by examination of the data of Experiment 2 and the male data of Experiment 3 (Figures 3 and 4). In these graphs the PL function appears to follow the P function for the primacy part of the sequence and the L function for the recency part. Perhaps when information is presented to both modalities, the subject can respond on the basis of that modality which most adequately represents the part of the sequence from which the test item is drawn. That subjects can store independent modality-specific list information is suggested by the data of Smith (1969). Using the serial position memory task with adult subjects, he presented sequences of digits both visually and auditorally, but then probed with either a written or spoken cue. The same interacting functions were found as for the P and L conditions of the present study, suggesting that the cue tapped the memory system specific to its modality.

The abrupt shift in performance between the ages of 5 1/2 and 6 1/2 at the first serial position in both P and PL conditions (Experiment 1) is more likely to be a mediation effect similar to those described by Reese (1962). Conceptually, the mediator is in part a way of preserving information for later use while processing of new material is going on. It is therefore reasonable that such a process should have its major effect at the beginning of a list rather than at the end. A "sensory" effect, on the other hand, is likely to be strongest at the time of input of the information, or at the end of the list.

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